International Journal of Research
Available at https://edupediapublications.org/journals
e-ISSN: 2348-6848
p-ISSN: 2348-795X
Volume 04 Issue14
November 2017

# Evaluation of Mechanical Properties of Groundnut Shell & Date Palm Powder Reinforced Polymer Composite

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**Abstract**

*The modern world can't been imagined its development without involving the concept behind advancement in composite material. The numbers of researches are going on composite material in order to achieve desire standards. The hybrid composite have been emerged and have potential reinforcement for composites and hence gains attraction for further researches. This is due to their application for which are more benificial offer low cost, low density, tensile strength etc. The present work is on development of roofing sheet material using date palm and groundnut shell particle reinforced polyester composite. Previously, it was proven that groundnut shell particle reinforced composite is applicable to roofing sheets. This project's main motive is to add the date palm seed powder to groundnut shell particle reinforced polyester composite to show the variation. These hybrid composites are fabricated by using hand layup method. Three samples are prepared named "A","B","C". In which sample A is only with groundnut shell particle, sample B & C are fabricated with different proportion of groundnut and date palm seed powder. Specimens were cut from the fabricated material according to the ASTM standard for different experiments for tensile test, hardness, and impact test. This review aims to show the improvement in properties by adding date palm seed powder to the composite material.*

**Introduction:**

Composite material can be characterized as a mix of at least two materials on large scale with various properties, or a framework made out of at least two physically unmistakable stages isolated by a particular interface whose mix produces total properties that are prevalent from multiple points of view, to its individual constituents. The network goes about as the building square which keeps any kind of outer harm to the composite while the nearness of support is to enhance its mechanical and warm properties, for example, quality, pliability, firmness, sturdiness, warm conductivity and so forth i.e. the lattice can be believed to be the parent material to which different changes in physical, while mechanical and warm properties are realized by expansion of fillers. Composite materials comprises of two constituents one is grid and other is support. The essential period of a composite material which is having ceaseless character and present in more noteworthy amount is called network. The principle capacity of this framework is to goes about as a

fastener and to hold the strands in the coveted position accordingly exchanging the outer load to support. While the other constituent is fortification, can be either engineered or characteristic filaments. The mechanical property for the most part relies on the shape and measurements of fortification. A few common filaments fortified polymer composites are brought into the focused market for the request of expanding condition security. Grids which utilized are either thermoset or thermoplastic. Ordinarily utilized saps are thermoset framework Polyester, Epoxy and phenolic. while polypropylenes, polyethylene and elastomers goes under thermoplastic network.

Epoxy resins are nothing but polyether resins which contains more than one epoxy group capable of being converted into the thermoset form. Because of their following characteristics of epoxy or polyester resin systems are used for preparing composite components.

**Literature**

Botanically, groundnut is known as Arachishypogeae belongs to the family Leguminosae. Fourth largest oilseed production in the world is from groundnut. Groundnut is the second largest producer in India after china. The complete seed of groundnut is known as pod and outer most layer of groundnut is called shell. The lignin proportion of groundnut shell fiber is much greater than that of baggase, rice, banana, jute, hemp, husk, kenaf and sisal fibers. The content of hemicelluloses of the fiber is 18.7%, lignin 30.2%, cellulose 35.7% and ash 5.9% content. In these, lignin is called as cementing agent, which binds fiber of individual cells together. The hemi celluloses is preferred for moisture absorption.

For many years, the date palm phoenix dactylifera playing an important role in day-to-day life for the people. Today worldwide utilization, production and industrialization of dates are all continuously increasing, has rich content of nutrients for which it earned great importance. Date pits are considered as waste which represents average of 10% of date fruits. Mechanical properties like corrosion resistance, strength, wear resistance are acquires to improve extensively by adding hard fillers. Few aspires of engineering polymers are ease of fabrication, density, corrosion resistance. Upon particle reinforced polymer matrix development cost reduction and stiffness improvement qualities are scope for commercial requirements]. The useful filler particle to improve mechanical, thermal and electrical properties is silica which is proven. Increase in fatigue and flexural strength increment in surface area of particle reinforced noticed by Nakamura et al.

Jacob Olaitan AKINDAPO, Umar Alhaji BINNI, Olawale Monsur SANUSI(2015): This paper is on the development of roofing sheet material using groundnut shell particles and epoxy resin as composite material. Three unique specimens of material sheets"A", "B" and "C" were arranged and created from three diverse weight molecule length sizes of 0.5mm,1mm and 1.5mm at a weight proportion of 70:30 amongst epoxy and groundnut shell. The example material sheets were thrown physically and the rate of water ingestion, rigidity, affect and flexural quality because of bowing and redirection were all tentatively assessed. In this printed material example A was adoped for its brilliant properties which have most minimal rate of

water absorptivity esteem ,with the most astounding effect esteem.

S.Muthukumar, K.Lingadurai(2014): Paper investigation is on developing of PMC using coconut shell powder and groundnut shell powder in different volume and found its tensile strength, impact strength and flexural property with engineering properties. The resultant composites are more environmental friendly and used in automobile, railway coach, military applications.

G.C. Onuegbu et al(2013): Explored the mechanical properties of polypropylene composites with ground nut husk powder at various molecule sizes and found that the nearness of ground nut husk enhanced the rigidity, modulus, flexural quality and effect quality of the composites.

B.H.Sada,Y.D.Amartey,S. Bako(2013):):paper Investigation was in the utilization of Groundnut shell as fine total fortification substitution. The appropriateness of groundnut shell powder as a constituent material in concrete was done investigaion by supplanting extents by their volume of fine total with groundnut shells. Physical properties of groundnut shells, concrete and totals were resolved. Cement of size measuring 150x150x150mm were thrown. Increment in level of groundnut shells in the threw block prompted a comparing diminishment in densities and compressive quality esteems. At a substitution of 25% esteem or more, of fine totals with groundnut shells; lightweight cement were delivered which could be utilized where low anxiety is required.

**MATERIALSANDMETHODS**

In this chapter we deal with the materials that are used in the study of the materials are processed and its methods.

The materials that are used in the present concern of Studies are:

1. Matrix material

Composite material is a multi-stage framework comprised of grid material and fortifying material. Lattice material is a nonstop stage, and it incorporates metal network composite materials, inorganic non-metallic grid composite materials and polymer framework composites by the diverse network materials.

Matrix material serves several functions, the important ones being:

-It binds the fibers together.

-It supports the overall structure.

-Protects the composites from the incursion of external agents such as chemicals, humidity, etc.

-Transfers stresses and loads within the composite structure.

- Protects the fibers from damage due to handling.

Table 3.1 matrix material temperature comparison

Performance of polymers is highly sensitive to several environmental variables. For instance, while mechanical properties of metals are temperature sensitive only in proximity of melt temperature, polymers' mechanical properties are highly sensitive to heat.

**a) Polyester resin**

polyester resins are the most widely used thermosets in commercial, mass- production applications, thanks to their ease of handling, good balance of mechanical, electrical and chemical properties, and relatively low cost.

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Figure: 3.1 polyester resin

Across-linked unsaturated polyester resin of a linear unsaturated polyester with the following structure

**b) MEKP Hardener**

MEKP is a Liquid Hardener. MEKP is made out of methyl ethyl ketone peroxide, an impetus, added to polyester and vinyl saps. At the point when MEKP is blended with the tar, the subsequent substance response makes warm develop and cure or solidify the gum. MEKP Catalyst is regularly added to polyester pitch at a proportion of in the vicinity of 1 and 3%, as per the pot-life and cure speed required and the encompassing temperature. Continuously take after the rules that go with your particular tar framework


Figure: 3.2MEKPHardener

**c) Cobalt octoate Accelerator**

A quickening agent is added to the catalyzed sap to empower the response to continue at workshop temperature and additionally at a more prominent rate. Since quickening agents have little effect on the sap without an impetus they are now and again added to the pitch by the polyester maker to make a 'pre-quickened' gum. Cobalt is a typical quickening agent. Cure is exothermic: as the parts crosslink, they discharge warm.


Figure: 3.3 cobalt octoate

**2) Filler Materials**

**a) Groundnut shell powder**

The groundnut is considered as a green yield buildup which as extensive variety of use in field, for example, vitality generation, warm protection. The quality of the composite materials depends to a great extent on the planning of the shells. The groundnut shells of enough amount were gathered and dried it in daylight. The dried groundnut shells were washed completely with water to take away the sand particles and different pollutions. At that point the shells dried and pounded to diminished to its size to littler and crushed in a machine to ensure the particles were sieved to under 1mm.

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figure: 3.4 groundnut shell powder

**b) Dates seed powder**

Date seeds, which constitute 6-15%of the total weight of the ripe date. Date seed containsonly10% of moisture and remaining contains90% contains dry matter which fixed ash content is about 5.67%and major constituents are magnesium and calcium and minor traces of phosphorous, iron. The date seed of enough quantity were collected and dried it in sunlight. The dried date seed were washed thoroughly with water to take away the sand particles and other impurities. Then the shells dried and hammered to reduced to its size to smaller and grinded in a machine to make sure the particles were sieved to less than 1mm.

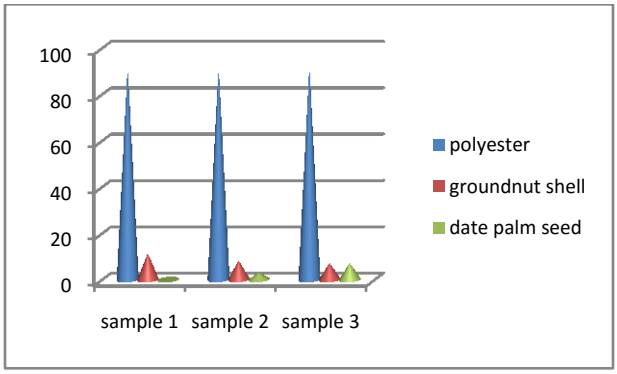
Figure: 3.5 dates seed powder

**Fabrication:**

Mixtures with polyester resin, accelerator and corresponding catalyst as recommended are prepared to fabricate the composite. Groundnut shell and date seed powder with an average particle size of less than 1mm are filled in polyester resin matrix to prepare the composites.

Table 4.1 Preparation of samples through hand layup process

| SAMPLES | Composition | Volume(%) |
|---|---|---|
| sample 1 | Polyester resin + groundnut shell powder | 90+10 |
| Sample 2 | Polyester resin + groundnut shell powder + dates seed powder | 90+7.5+2.5 |
| Sample 3 | Polyester resin + groundnut shell powder + dates seed powder | 90+5+5 |




**MATERIAL TESTING:**

Preceding assembling, numerous materials, outline, and creation choices are made to guarantee item unwavering quality and legitimate execution. To approve these choices, an assortment of testing strategies are utilized. The techniques are gathered into two noteworthy classes:

• Mechanical Testing

• Non-Destructive Testing (NDT)

Mechanical testing, which is also known as destructive testing, is accomplished by forcing a part to fail by the application of various load factors. In contrast, non-destructive testing does not affect the

part's future usefulness and leaves the part and its component materials in tact.

**Tensile test**

This test is carried out with accordance of IS 1608:2005. This testing process involves the test specimen to be placed in a testing machine and applies tension to it till it get fractured. The tensile force recorded as function of increase in the gauge length. A point load was applied along the center of the span of the corrugation. The maximum load at the point was noted, which gives the splitting load for the corrugated specimen.

Figure: 5.1 Test piece

**B)HardnessTest**

Hardness is a normal for a material, not a basic physical property. It is characterized as the protection from space, and it is dictated by measuring the perpetual profundity of the space. This test is completed with understanding of ASTM D 2240.

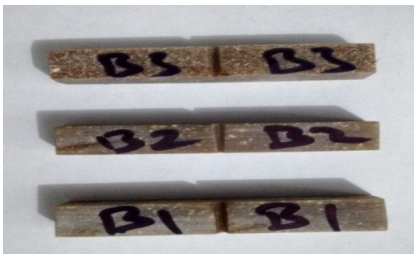
**C) Impact Test**

Amid the testing procedure, the example must be stacked in the testing machine and permits the pendulum until the point when it cracks or breaks. Utilizing the effect test, the vitality expected to break the material can be measured effectively and can be utilized to gauge the durability of the material and the yield quality.

Impact tests measure resistance to shock loading or impact by determining the amount of energy absorbed by the test specimen. There are two basic types of impact tests:

• Pendulum

• Drop Weight




**Results**

**Tensile Test**

The results obtained for the tensile test is shown below

S : samples

b : Width (mm)

t : thickness (mm)

A : Area ($mm^2$)

L : Load (KN)

TS : Tensile strength ($N/mm^2$)

Table 6.1 Tensile test results

| s | b | t | A | L | TS |
|---|---|---|---|---|---|
| 1 | 12.49 | 13.25 | 165.49 | 2.6 | 15.71 |
| 2 | 15.34 | 13.25 | 203.25 | 3.68 | 18.105 |
| 3 | 12.79 | 13.24 | 169.34 | 3.08 | 18.188 |

The results obtained for the tensile test on heating specimen up to 200°C

Table 6.2 Tensile test results on heating specimen

| s | b | t | A | L | TS |
|---|---|---|---|---|---|
| 1 | 13.4 | 12. | 170.18 | 1.6 | 17.86 |

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Volume 04 Issue14
November 2017

| | | | | | |
|---|---|---|---|---|---|
| | | 7 | | 4 | 3 |
| 2 | 12.7 | 12.5 | 158.75 | 1.24 | 15.622 |
| 3 | 12.27 | 13.5 | 165.645 | 1.72 | 12.798 |

**Hardness Test (shore D)**

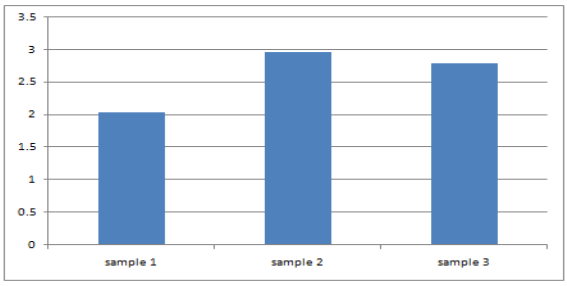
The results obtained for the hardness test is shown below

Table 6.3 Results for hardness test

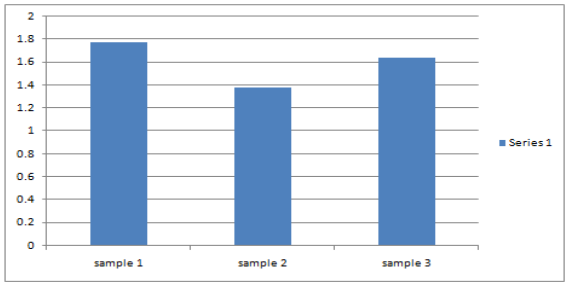
| Specimen | Hardness (DUROMETER) |
|---|---|
| Sample 1 | 78 |
| Sample 2 | 80 |
| Sample 3 | 85 |

Percentage elongation:

At room temperature

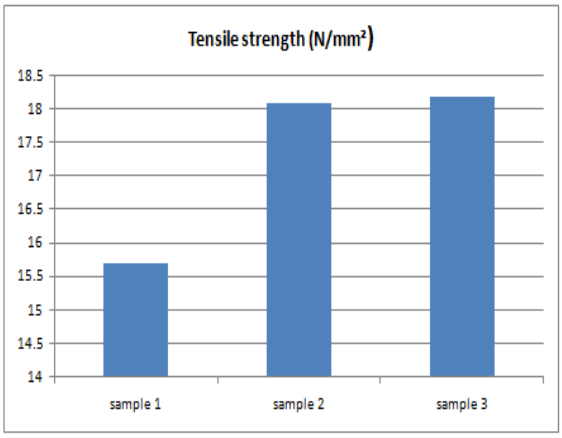



At 200°C temperature

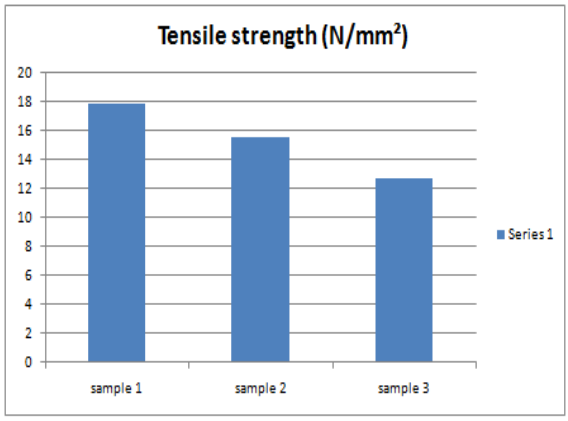



**Tensile strength:**

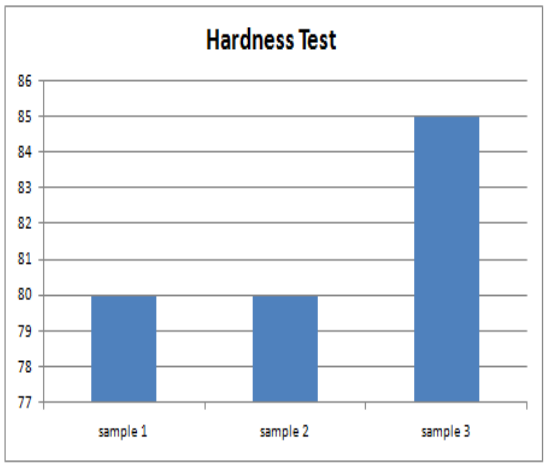
At room temperature




At 200°C temperature




**Hardness:**



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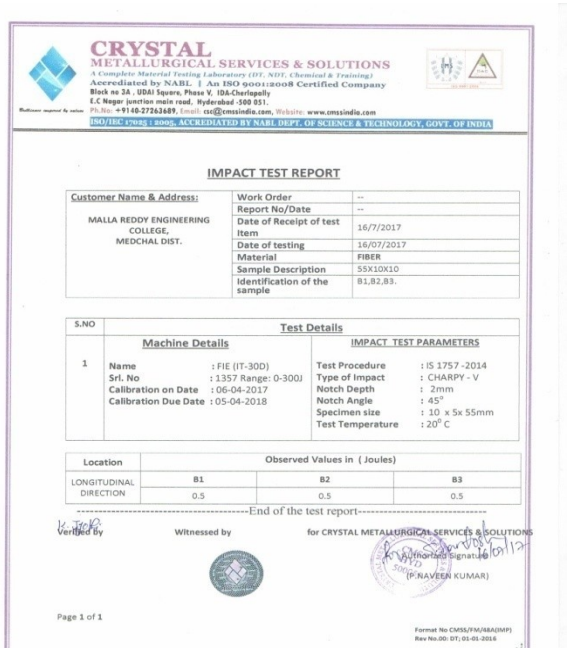
Mechanical testing reports

- Impact test report



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IMPACT TEST REPORT

| Customer Name & Address: | | |
|---|---|---|
| MALLA REDDY ENGINEERING COLLEGE, MEDCHAL DIST. | Work Order | -- |
| | Report No/Date | -- |
| | Date of Receipt of test Item | 16/7/2017 |
| | Date of testing | 16/07/2017 |
| | Material | FIBER |
| | Sample Description | 55X10X10 |
| | Identification of the sample | B1,B2,B3. |

| S.NO | Test Details | |
|---|---|---|
| | Machine Details | IMPACT TEST PARAMETERS |
| 1 | Name : FIE (IT-30D)<br>Srl. No : 1357 Range: 0-300J<br>Calibration on Date : 06-04-2017<br>Calibration Due Date : 05-04-2018 | Test Procedure : IS 1757 -2014<br>Type of Impact : CHARPY - V<br>Notch Depth : 2mm<br>Notch Angle : 45°<br>Specimen size : 10 x 5x 55mm<br>Test Temperature : 20° C |

| Location | Observed Values in ( Joules) | | |
|---|---|---|---|
| LONGITUDINAL DIRECTION | B1 | B2 | B3 |
| | 0.5 | 0.5 | 0.5 |

----------End of the test report----------

Verified by Witnessed by for CRYSTAL METALLURGICAL SERVICES & SOLUTIONS
Authorised Signature
(P.NAVEEN KUMAR)

Page 1 of 1
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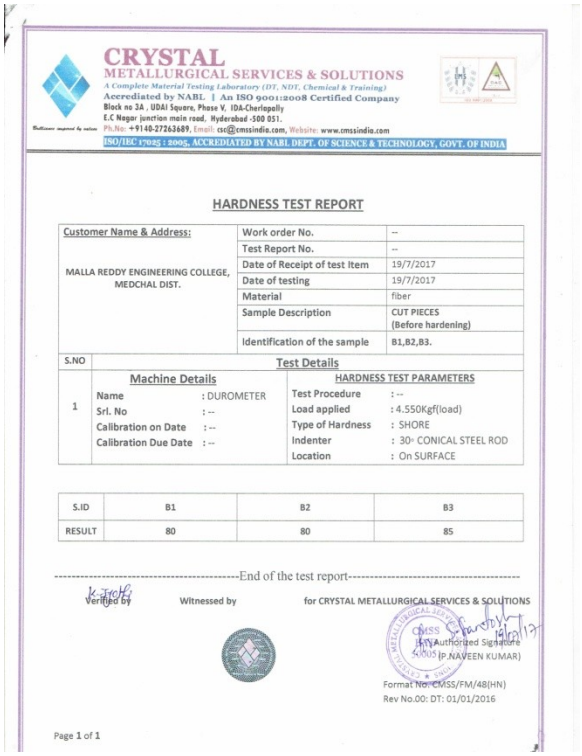
Rev No.00: DT; 01-01-2016

- Hardness test report



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HARDNESS TEST REPORT

| Customer Name & Address: | | |
|---|---|---|
| MALLA REDDY ENGINEERING COLLEGE, MEDCHAL DIST. | Work order No. | -- |
| | Test Report No. | -- |
| | Date of Receipt of test Item | 19/7/2017 |
| | Date of testing | 19/7/2017 |
| | Material | fiber |
| | Sample Description | CUT PIECES (Before hardening) |
| | Identification of the sample | B1,B2,B3. |

| S.NO | Test Details | |
|---|---|---|
| | Machine Details | HARDNESS TEST PARAMETERS |
| 1 | Name : DUROMETER<br>Srl. No : --<br>Calibration on Date : --<br>Calibration Due Date : -- | Test Procedure : --<br>Load applied : 4.550Kgf(load)<br>Type of Hardness : SHORE<br>Indenter : 30° CONICAL STEEL ROD<br>Location : On SURFACE |

| S.ID | B1 | B2 | B3 |
|---|---|---|---|
| RESULT | 80 | 80 | 85 |

----------End of the test report----------

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Rev No.00: DT: 01/01/2016

Page 1 of 1

**Conclusion:**

The aim of the project is to develop the groundnut shell reinforced polyester composite by adding date seed powder as reinforcement.

Three different grades of sample roofing sheets were produced, the samples differ from one another by varying the reinforcement particles with same proportion of polyester resin during production.

- Sample C had the highest tensile strength of 18.188N/mm² followed by sample B and A of 18.105 N/mm² and 15.711 N/mm² respectively
- Likewise hardness of sample C had highest followed by sample B and A respectively.
- It was found that variation shown in impact test is far less, as the proportion of shell powders is less in quantity .

Sample C has the best possible proportion than sample B and A to be taken into consideration for the production of commercial use. Sample “C” was adopted in this work because of its excellence performance properties. The results revealed that addition of date seed powdered particles with groundnut shell particles can be used as reinforcement for polymer matrix for the production sheets.

**REFERENCES**

[1] Jacob Olaitan AKINDAPO1, Umar Alhaji BINNI1, Olawale Monsur SANUSI2

[2] Had done project on groundnut shell powdered reinforced composite for the manufacturing of roofing sheets which was success. My work and results revealed that addition of date seed powder to groundnut shell

particles as reinforcement implies more strength, especially hardness.

[3] R.N. Rothon, Mineral fillers in thermoplastics: filler manufacture, J. Adhesion, 64 (1997) 87–109.

[4] L.E. Nielsen and R.F. Landel, Mechanical properties of polymers and composites. seconded. Marcel Deckker, New York, 1994, pp.377–459.

[5] I.Yamamoto, T. Higashihara and T. Kobayashi, Effect of silica-particle characteristics on impact/usual fatigue properties and evaluation of mechanical characteristics of silica- particle epoxy resins, Int. J. JSME, 46 (2) (2003) 145– 153.

[6] G.C. Onuegbu, S.C. Nwanonenyi, M.U.Obidiegwu "The Effect of Pulverised Ground Nut Husk on Some Mechanical Properties of Polypropylene Composites", International Journal of Engineering Science Invention, Vol.2(6), pp.79- 83, 2013.

[7] Vasanta V Cholachagudda , Udayakumar.P.A , Ramalingaiah "Mechanical characterisation of coir and rice husk reinforced hybrid polymer composite", International Journal of Innovative Research in Science, Engineering and Technology ,Vol. 2(8),2013.

[8] G. U. Raju, V. N. Gaitonde, S. Kumarappa, "Experimental Study on Optimization of Thermal Properties of Groundnut Shell Particle Reinforced Polymer Composites", International Journal of Emerging Sciences, Vol .2(3), pp 433- 454, 2012.

[9] S.Muthukumar, K.Lingadurai "Investigating the mechanical behaviour of coconut shell and groundnut shell reinforced polymer composite", Global Journal Of Engineering Science And Researches, Vol.1(3) pp 2348 – 8034, 2014.

[10] P. Procter, J. Solc, Improved thermal conductivity in microelectronic encapsulants. IEEE Trans on Hybrids ManufTechnol, 14(4) (1991) 708–13.

[11] Y. Nagai, G.C. Lai, Thermal conductivity of epoxy resin filled with particulate aluminum nitride powder, J. Ceram SocJpn, 105(3) (1997) 197–200.

[12] N.M. Sofian, M. Rusu, R. Neagu and E. Neagu, Metal Powder-filled Polyethylene composites, V.thermal properties, J.thermoplastic composite materials 14(1)2001,20-23

[13] Y.P. Mamunya, V.V. Davydenko, P. Pissis and E.V. Lebedev, Electrical and Thermal Conductivity of Polymers Filled with Metal Powders, J. European Polymer,38(9)(2002)1887-1897

[14] Patnaik Amar, Md. Abdulla, SatapathyAlok , B. Sandhyarani and K. S. Bhabani, A study on a possible correlation between thermal conductivity and wear resistance of particulate filled polymer composites, J. Materials and Design ,(In press) (2009).

[15] Tsao T.N.G., Thermal Conductivity of Two Phase Materials, J. Industrial and Engineering Chemistry, 53(5) (1961) 395–397.

[16] Cheng S.C. and Vachon R.I., The Prediction of the Thermal Conductivity of Two and Three Phase Solid Heterogeneous Mixtures,B.Tech Thesis 2014 Mechanical Engineering Department, N.I.T. Rourkela Page 31 Int. J. of Heat Mass Transfer, 12(3) (1969)249–264.

[17] Oksman K., Mathew A. P., Långström R., Nyström B., Joseph K., 2009. The influence of fibre microstructure on fibre breakage and mechanical properties of natural fibre reinforced polypropylene, Composites Science and Technology 69, p. 1847.